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Protective effects of social networks on disability among older adults in Spain

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Abstract

The loss of autonomy at advanced ages is not only associated with ageing, but also with the characteristics of the physical and social environment. Recent investigations have shown that social networks, social engagement and participation act like predictors of disability among the elderly. The aim of this study is to determine whether social networks are related to the development and progression of disability in the early years of old age. The source of data is the first wave of the survey "Processes of Vulnerability among Spanish Elderly", carried out in 2005 to a sample of 1 244 individuals. The population object of study is the cohort aged 70 to 74 years in metropolitan areas (Madrid and Barcelona) and not institutionalized. Disability is measured by the development of basic activities of daily life (ADL), and instrumental activities of daily life (IADL). The structural aspects of the social relationships are measured through the diversity of social networks and participation. We used the social network index (SNI). For each point over the SNI, the risk of developing any type of disability decreased by 49% (HR = 0.51, 95%CI = 0.31-0.82). The SNI was a decisive factor in all forecasting models constructed with some hazard ratios (HR) that ranged from 0.29 (95%CI = 0.14-0.59) in the first model to 0.43 (95%CI 0.20-0.90) in the full model. The results of the present study showed a strong association between an active social life, emotional support provided by friends and confidents and disability. These findings suggest a protective effect of social networks on disability. Also, these results indicate that some family and emotional ties have a significant effect on both the prevalence and the incidence of disability.

Keywords: Aging; Social support; Disabled Persons; Health Status Disparities.

1. Introduction

The rapid increase of population aging and growth of disability among older people, make it very important to identify the factors that influence the onset and/or progression of disability. The identification of these factors will help to prevent, or at least to delay, the onset of disabilities and thus, it will reduce dependence situations and long-term cares generated from them.

Over recent decades there have been various attempts to define the concept of disability. One of the most widely accepted definitions is the one of Verbrugge and

Jette (1994) that conceives disability as the difficulty in carrying out activities in any aspect of life (from hygiene to hobbies, from daily shopping to sleep) due to physical or health problems. Disability is understood as a multidimensional and interactive process that results from the interaction between health conditions and other personal characteristics (age, sex, educative level, etc...) and the social and environmental factors. The authors describe how chronic and acute diseases affect the functioning of specific body systems, basic activities (physical and mental) and activities of daily living. They also, establish a set of personal factors (intra-and extra-individual) and environmental factors (demographic, social, lifestyle, psychological, environmental or biological) that may accelerate or delay the process.

The causes of disability are multifactorial, including physical, psychological and social factors (Link and Phelan, 1995; Dear et al., 1997; Ebrahim, 2000; MacIntyre and Ellaway, 2000; Ortún Rubio, 2000; Subramanian and Kawachi, 2002; Otero et al., 2006). Although the presence of disability is not exclusive of older people and it is not an inevitable consequence of aging, it has a significant presence in old age, especially in older ages where fragility situations increase (Jette et al., 1990; Simons et al., 2000; Waidmann and Liu, 2000; Abellán et al., 2001; Freedman et al., 2002). There is evidence that the process of disability in the elderly can be accelerated because of biological and psychosocial changes associated with aging, disease and/or changes in health habits (Verbrugge and Jette, 1994; Link and Phelan, 1995; Regidor et al., 1997; Subramanian and Kawachi, 2002; Puga, 2003; Avlund et al., 2004a; Preston et al., 2005). However, the process of disability may also be affected by external other factors such as social factors, for example social networks. These factors may regulate the speed and the direction of the disability process (Mendes de Leon et al., 1999, 2001; Seeman, 2000; Avlund et al., 2004b; Giles et al., 2004; Otero et al., 2006).

To well known risk factors such as educational level, income level, social stratum, or lifestyle (Regidor et al., 1997; Freedman and Martin, 1999; Ebrahim, 2000; Ortún Rubio, 2000; Subramanian and Kawachi, 2002; Puga, 2003; Preston et al., 2005) we can also find factors such as the social network's, social integration and social participation, which have an effect on the social vulnerability of individuals, acting as predictors of personal situations related to health, cognitive and functional autonomy, welfare and satisfaction among the elderly (Freedman and Martin, 1999;

Grundy and Glaser, 2000; Zunzunegui et al., 2001; Mendes de Leon et al., 2003; Avlund et al., 2004a,b; Otero et al., 2004).

According to Berkman and Glass (2000), the social network is the tissue of social relations that the individual has and it is related to health through a variety of psychosocial mechanisms: (a) It provides emotional and instrumental social support, and it helps to make decisions and to provide information. (b) There is a social influence between the actors of the network. (c) Through the participation and social commitment. (d) By the contact person to person, and (e) through the access to material resources. These psychosocial mechanisms have an effect on health through changes in lifestyles (e.g., tobacco and alcohol consumption), psychological mechanisms (self-esteem or self-efficacy) and physiological mechanisms (related to the immune system or to the cardiovascular reactivity, among other factors).

Recently, research has delved into the protective influence of social relationships on health (Mendes de Leon et al., 2001; Avlund et al., 2004a,b; Giles et al., 2004; Otero et al., 2006). For example, some authors have shown that seniors who have wide social relationships are more likely to survive (Vogt et al., 1992; Glass et al., 1999) and show better results in health and autonomy (Seeman, 2000). Besides the extent of social networks, the frequency of contact with friends, or the strength of the family network (Mendes de Leon et al., 1999, 2001; Avlund et al., 2004a,b) have shown protective effects against the onset of disability, slowing its progression or even increasing the level of recovery.

The aim of this study is to determine whether social networks are related to the development and progression of disability in the early years of old age.

2. Material and methods

The study was conducted in two phases: (i) In a first crossectional phase, we examined the status of autonomy and level of disability at the beginning of old age, and their relationship with the individual's social network and its characteristics. (ii) In a second phase, from the first wave of the survey, but developing a retrospective longitudinal study, we analyzed the incidence of disability in these early years of old age, and the relationship between the individual's social network and timing of incidence of disability.

We used data from the survey "Processes of vulnerability in old age. Longitudinal study of environmental and social effects". This is a longitudinal study,

that consists on carrying out a tracking survey on a population cohort in the early years of old age, and collecting environmental social data and individuals who act or may act as shattering or accelerators of the increasing vulnerability. The survey was conducted through personal interviews.

2.1. Study population

The study population was a cohort between 70 and 74 years of age, residents in family building of houses (not institutionalized), in large urban areas.

Space areas were selected on the one hand (a) the municipality of Madrid, a long town, which provides districts with a large variety of demographic and socioeconomic characteristics (2,938,723 inhabitants, 151,832 inhabitants aged 70-74 years) and on the other hand, (b) the municipality and the first crown of the metropolitan area of Barcelona, a similar area in size and diversity in the demographic composition, to the municipality of Madrid (3,402,000 inhabitants, 186,518 inhabitants aged 70 to 74 years).

There were also included people who have cognitive impairment, as the analysis of disability caused by cognitive problems is one of the objectives of the study, and their exclusion could slope the sample reducing the observation of severe disability. In those cases where we detected a situation of cognitive impairment, it required the participation of a reporter or proxy, a family member or a caregiver of the fellow, to complete the questionnaire.

The studied population consisted of the legal population of the municipalities observed in that age range, according to the latest Census of Population and Housing 2001 (National Statistics Institute, INE).

In each of the selected regional areas (Madrid and Barcelona) were grouped into four strata sections taking into account the age structure (according to percentage of population over 65 in each section) and the socioeconomic structure of the population (according to percentage of population with completed primary education).

The sample size was calculated to estimate a proportion, assuming normality, for $\alpha = 0.05$, assuming a margin of error (ε) of 0.03 and worst-case scenario ($p = 0.5$) using a simple random sampling. According to these parameters, the minimum number of individuals who should compose the sample was 524 individuals in each of the selected regional areas. Under an assumption of a 15% loss of subjects during

the follow-up, the initial sample to work with is 625 individuals in each regional area. This implies a minimum initial random sample of 1250 individuals. Finally, the sample calculated size using a proportional allocation, we determined the number of individuals sampled in each stratum.

2.2. Variables

Disability was measured by self-reported difficulties and/or inability to develop activities of daily living (ADL) and instrumental activities of daily living (IADL). The analyzed activities were observed in the Katz and Lawton (19….) test, respectively. This analysis used a multinomial variable: (1) no disability, (2) only instrumental disability (IADL), and (3) with basic disabilities (BADL). With this categorization we pretend to classify fellows according to the different level of attention and care they need.

Social network and social participation: The structural aspects of social relations were measured through the social network diversity and participation. We used the Social Network Index (SNI) (Escobar et al., 2008; Escobar, 2009). This index provides information about links at home, with children and grandchildren, with brothers and friends, intimacy, networking, social activities, and dynamism. The social network characteristics (number, proximity, frequency of contacts) were measured differentially for each of the links. The sum of the partial scores permits to obtain a global indicator of network diversity (presence and strength of contacts in different types of links). The measure "frequency of contacts" were observed for personal and telephone contacts, as recommended by Avlund et al. (2004a), since its content may be complementary. The theoretical development of the scores of the SNI could vary between 0 and 2 points for the overall and between 0 and 1 for each of its two components (index of social structure and social participation rate).

2.3. Covariables

In the analysis we introduced information related to variables that might act as confounders, with the aim of controlling their effects. These variables were, on one hand, demographic and basic socio-economic variables, such as age, gender, profession of the head of the family prior to retirement (manual workers and labourers, administrative and service personnel, businessman, managers and professionals), educational level (did not go to school, has gone to school but did not

completed primary school, complete primary school, completed secondary school and university studies), homeownership (homeowner in which usually lives or not), family income (euros per month that enter in the household from all sources). On the other hand, health status variables such as comorbidity (number of diagnosed diseases) and depressive symptoms were measured with the Centre for Epidemiologic Studies Depression Scale (CES-D scale) (Radloff, 1977). Likewise, in the analysis we introduced variables related to lifestyle such as smoking (non-smoker, ex-smoker, moderate smoker (10 cigarettes or cigars a day or less) and smoker (10 cigarettes or cigars, or more per day)), alcohol consumption (non-drinkers, low consumption (less than 30 g/day of alcoholic), moderate consumption (between 30 and 50 g/day), heavy drinking (between 50 and 70 g/day) and high consumption (more than 70 g/day)) and exercise (no exercise, occasional physical activity, physical activity several times a month and physical activity several times a week). We also took into account the variable negative biographical events in the last 10 years (death of a close relative, serious illness of a close relative, death of a friend, retirement self or spouse and reduced household income).

2.3. Statistical analysis

First, a descriptive analysis of the study population was made according to the control variables. For this description we calculated the indexes of central tendency and dispersion for quantitative variables and frequencies for categorical variables.

In cross-sectional study phase, to analyse of the relationship between social network, measured by the SNI, and the level of disability we used techniques such as multinomial logistic regression. We took as the dependent variable the severity of disability in three categories: no disability, instrumental disability and basic disability. Following the recommendations of Hosmer and Lemeshow (1989), in a first step, we selected the variables that would be introduced in the multivariate analysis using bivariate analysis. The statistical tests used were according to the nature of the variables, ANOVA or Chi-square or its equivalent in cases that do not meet the criteria for applying these tests. Any independent variable obtained a higher level of significance lower than 0.25 in these tests was introduced in multivariate models. Then, we make the final analysis using multinomial logistic regression.

In the retrospective phase, using Cox's regression, we analyzed the prognostic factors for the onset of disability. However, at this stage of analysis we identified an

error in recording the raw data due to an equivocal response was not provided properly. Thus, a large number of men, when asked "How long have you had problems to do this activity?" referring to IADL related to domestic activities, they answered "always", which does not really mean a physical challenge to carry out these activities, but it is the result of gender role as the IADL related to home care, especially in these ages, have traditionally been exclusive responsibility of women. To avoid the effect of this anomaly of the data in the results, we used only data after 40 years old to carry out the retrospective calculation.

3. Results

3.1. Description of population

The final sample size was 1286 individuals, 633 (49.2%) from Barcelona and 653 (50.8%) from Madrid.

The answers to questions about the control variables are summarized in Table 1. The average age of the sample was 73 $\pm$ 1.7 years ($\pm$S.D.), and women represented 58% of the entire sample. In more than the half of the sample (52.3%), the head of household was a manual labourer or worker and 16.4% were professionals and businessmen. Only 8% of these people had not experienced any negative biographical event in recent times.

With regard to health habits, 62% had never smoked and only 10% currently smoked. The results show that nearly 9 out of 10 people were non-drinkers (62.5%) or low consumers (less than 30 grams per day of alcohol) (26.5%). On the other hand, more than half of respondents doing some physical exercise several times a week and 28% did not practise any physical activity. Among those who did some exercise, 77% walked.

The average score on the depressive symptoms scale CES-D was 10.4 $\pm$ 8.0 points. Based 16 as a cut-off, as recommended by Radloff (1977), it was found that 19% of respondents was above this point, that is, it was in risk of depression.

In terms of comorbidity, 13% said not having any chronic disease, 43% had been diagnosed with three or more illnesses and the average of diseases diagnosed per person was 2.4 $\pm$ 1.7.

Other variables that help to understand the composition of the sample in terms of its socioeconomic and health characteristics are described below. About 63% of

elderly had attended primary school or less. In this population, 5% of total respondents reported not knowing to read or write.

A total of 79% owned the house in which they lived, and 47% assured that the monthly income was 900 € or less. It should be noted here that 32% of respondents chose not to declare their income. In terms of health status, more than half (51%) said that they had a good or a very good one, and 13% described it as bad or very bad.

3.2. Description of social networks

With the intention of making a first approach to the description of the social networks of the sample studied, we carried out a comparative analysis to see the distribution of the control variables of the SNI, which was built, as each one of the two components of this indicator: index of social structure and social participation. As shown in Table 2, the average score on the social network indicator for the entire population was 0.92 $\pm$ 0.34 points, 0.58 $\pm$ 0.19 for the index of social structure and 0.34 $\pm$ 0.25) for the index of social participation. The control variables gender, physical activity and depressive symptoms threw significant results for the complete indicator and for each of both indexes: The men obtained a higher mean score than women for the SNI (0.97 vs. 0.88) for the social structure index (0.61 vs. 0.55) and for social participation rate (0.36 vs. 0.33), the averages of both the SNI as the two indexes, increased with increasing frequency with of physical exercise, and there was a negative correlation between scores on the CES-D scale and the average score on the SNI and both indexes, that means, that as the symptoms of depression increased, the strength of social networks decreased. Those who experienced more negative biographical events in the past few years obtained a mean score significantly higher on the social participation rate and the SNI ($p = 0.001$ in both cases), but not for social structure index. The smoking habit was also found to have a statistically significant influence on the SNI ($p = 0.005$) and on the rate of social participation ($p = 0.007$). Indeed, the mean score of these indicators was higher the more healthy the individual's relationship with the tobacco was. Also, although in the opposite direction, the habit of alcohol consumption obtained significant results for the SNI. Curiously, the more alcohol was consumed, the more strength the individual's social network seemed to have ($p = 0.038$). These results should be taken with caution, as the number of people who reported a high or very high

consumption of alcohol represented only 1% of the total sample. As for the level of education, in social participation, mean scores were higher the higher the educational level achieved ($p = 0.010$). Finally, the average index score in the social structure was significantly lower the higher number of diagnosed diseases was ($p = 0.034$).

In summary, the strength of the social network as a whole changed as all the control variables set excepting age, comorbidity, educational level and occupation of head of household. These changes seemed to affect, in most cases, to social participation and, lesser extent, to the social network structure.

As shown in Table 3, we also analyzed the distribution of means obtained at the SNI and both indexes based on the levels of disability used in this study. These results indicated a statistically significant difference at the $p < 0.0005$ for the SNI, $p = 0.007$ for the rate of social participation and $p < 0.0005$ for social participation rate, always in the sense that for lower score in the SNI and indexes, higher level of disability.

3.3. Transverse phase

To analyze the prevalence of disability, its relationship with social networking and other covariates retained we carried out a multinomial logistic regression analysis. We built progressive models adding in each one a variable or group of variables to be able to analyze the possible changes that may occur under the effect of social networks on disability. Thus, in Model 1 we only included the SNI, in Model 2 was introduced, in addition to the SNI the sex variable, in Model 3 we added living habits variables (smoking and exercise), in model 4 were added negative biographical events and in model 5, the final model, entered all control variables used for this study: all the above ones plus the variables of health status (comorbidity and depressive symptoms).

As shown in Table 4, for basic disability, the SNI maintained its significance in all the models excepting model 5, where it disappeared after introducing health status variables. It should be taken into account, that the variable exercise also showed an association with basic disability in the sense that people who did not practise any physical exercise were more likely to suffer basic disability (OR = 1.66, 95%CI = 1.14-2.42 in Model 3, and OR = 1.73, 95%CI = 1.18-2.42 in model 4) than those ones who practised any kind of exercise. This significance disappeared when

we introduced the variables of health status in the final model. These health variables show a strong association with the basic disability.

For instrumental disability, sex and health status variables were the only statistically significant.

When we analyzed the effect of the components and the SNI subnets separately, as it can be seen in Table 5, both social structure and social participation got significant results for basic disability, although it is the second one, which showed a stronger association with this type of disability.

As for the subnets, the fact of having a partner was strongly associated with instrumental disability but not with basic disability. Given that basic disability, is closely related to the role of gender in this age, it seems logical that men, who had a female partner reported more "inability" to perform tasks such as preparing food, keeping house, etc. Nevertheless, the association found between the network of friends and disability, in addition to a strong positive association, it was given for the two levels of disability and provided a very similar level (OR = 0.52, 95%CI = 36-0.76 for the instrumental disability and OR = 0.51, 95%CI = 0.32-0.84 for basic disability). Social activities also showed a strong positive association with the basic disability, but not with the instrumental.

3.4. Retrospective longitudinal phase:

Then we conducted a retrospective analysis of data collected when appeared difficulty for each of the activities (ADL and IADL). By these tests we intended to assess the influence of social network on disability-free survival. We used Cox regression to adjust estimates of the effect of the social network for the control variables retained for this study. Models were built in the same way as were done for logistic regression analysis in the study of the prevalence of disability. To perform these tests, and because it is retrospective data and the SNI measures the social network only at the time of the interview, we made some adjustments. First, the analyses were performed only after 40 years old. This age was taken as the start of the follow-up because it was around this age when the incidence of disability began to appear and to accelerate. Before that age, disabilities that may appear usually are not due to deterioration because of time, which are the subject of this study, but mainly due to accidents, genetic inheritance or social issues related to the role of gender. On the other hand, the social network tends to remain stable over time,

especially if we take 40 years old as the start of monitoring. From this age the social network does not usually change so much about the links of children or brothers. The subnet that can suffer important changes in this age is that one related to grandchildren. For this reason we decided to eliminate the subnet of grandchildren from the SNI. To lighten the tables, we present only the variables that obtained significant results in each of the models constructed.

As shown in Table 6, in all of the models built, the SNI was identified as an important prognostic factor for the appearance of any type of disability, and that adjusted for all control variables as it was revealed in the final model. With all the control variables included in the analysis, the SNI showed that with increasing score in this index (it means that the social network became stronger) significantly decreased the risk of developing any type of disability from 40 years old. Specifically, for each point over the SNI, the risk of developing any type of disability decreased by 49% (HR = 0.51, 95%CI = 0.31-0.82).Other variables that, as expected by the results obtained in the analysis of the prevalence of disability made previously, were identified as important prognostic factors for the emergence of any disability were comorbidity (HR = 1.27, 95%CI = 1.17-1.38) and depressive symptoms (HR = 1.05, 95%CI = 1.04-1.07). Likewise, the exercise variable approached statistical significance in the first model that was involved (model 3) and was marginally significant in model 4 (HR = 0.74, 95%CI = 0.56-0.99).The significance disappeared after introducing health status variables.

The analysis by Cox regression of the factors that may predict the onset of basic disability it was found (Table 7) that the SNI was a decisive factor in all forecasting models constructed with some hazard ratios that ranged from 0.29 (95%CI = 0.14-0.59) in the first model to 0.43 (95%CI = 0.20-0.90) in the full model.In addition to the SNI, only health status variables were shown as prognostic factors of the basic disability.

4. Discussion

The results of the present study showed a strong association between an active social life, emotional support provided by friends and confidents and disability. This finding, in the context of those found by other studies in different geographical areas (Unger et al., 1999; Mendes de Leon et al., 2001; Michael et al., 2001; Avlund et al., 2004a; Giles et al., 2004), suggest a protective effect of social networks on disability.

These results are important for two reasons: First, because somehow contradicts the widespread belief that in Latin society in general and in the Spanish in particular, is the family that provides the social ties of health protection; The second reason is that social ties outside the family are the most susceptible to intervention from the health system, especially in the case of social activities. Thus, promoting the participation of the population in social activities reinforce feelings of appreciation and belonging to the group that can deliver great benefits in terms of health for these people.

These assumptions are supported by results both in the transverse and retrospective longitudinal phase of this study and are maintained when adjusting for control variables.

In the transverse phase of this study, we found that for every unit that decreases the score on the SNI the chance of suffering any type of disability is multiplied by 1.44. Thus, we can say that, after adjusting for sex, lifestyle habits (smoking and exercise), negative biographical events and health status (comorbidity and depressive symptoms), social networks taken as a whole (social structure and social participation) are associated with the presence of disability in Spanish people between 70 and 74. This statement agrees with results from other studies (Unger et al., 1999; Mendes de Leon et al., 2001; Michael et al., 2001; Avlund et al., 2004a,b; Giles et al., 2004). European, American and Australian studies that have measured both the social network and disability in a similar way as was done in this study. In addition to this, the association found between social network and the presence of disability is mainly given for the severely disabled.

However, the effect of the different components of social networks on disability is not homogeneous but is more determined by social participation than by the social network structure. Indeed, the OR obtained by the social structure component for instrumental disability does not have significant results and there was a weak significance for basic disability. However, the social component, it shows a strong influence on the presence of basic disability. Furthermore, partner and friends subnets are associated with the presence of instrumental disability, while only a strong social network of friends and an active social participation in social activities seem to protect the severely disabled.

Thus, we can say that social networks taken as a whole is associated with the presence of disability in the Spanish urban population between 70 and 74, and the severity of it. We should add that this effect is due mainly to social participation, and

within, social activities, rather than the family social network, which agrees with the findings of other studies in Europe (Avlund et al., 2004a,b), Spain (Otero et al., 2006) and America (Mendes de Leon et al., 2003). One would expect, due to cultural tradition, that the family social network has a greater effect on a Mediterranean culture as the Spanish, but has not been proven so because, as in other Spanish studies (Otero et al., 2006) has been active social participation which seems to protect most from the presence of disability. One explanation for this fact can be found in Santamarina (2002) suggesting that the older construct their social identity in opposition to this stereotype in Spain that treats old age with worthlessness, passivity, dependency and social death. Thus, participation in social activities is an example of persistence in the social network, while these activities have also a symbolic value of health, ability to move one's body (Otero et al., 2006).

These results, in general, are confirmed in longitudinal retrospective analysis. Indeed, they show that a strong and diverse social network protects against the onset of disability, for any type of disability and for basic disability in this population, this effect does not even disappear with the presence of state health variables for the general population. However, in addition to social participation, which also here is determining, the structure of the social network seems to play an important role as a predictor of both types of disabilities. Social participation implies commitment and social integration and benefits relationships with friends which reinforces the social roles of individuals and provides a feeling of being valued, of belonging to and membership to the group (Avlund, 2004).In line with this reasoning, we see that the subnets of the social structure that have been revealed as important protectors against the onset of disabilities have been the subnet friends and confidents for any type of disability and disability informers for basic findings are supported by other authors (Unger et al., 1999; Mendes de Leon et al., 1999, 2001).That means, that the formal and informal unfamiliar networks are those that predict the onset of disability in the most Spanish population.

The results of this study indicate that some family and emotional ties have a significant effect on both the prevalence and the incidence of disability. Specifically, we found a statistically significant association between having a partner and having friendly relationships with the levels of disability. These components of the social network have to do with the situation of loneliness related to living together and emotional loneliness. So, according to these results, the loneliness is revealed as an

important factor in the presence of disability among the elderly Spanish. These results agree with those found by other studies (Mendes de Leon et al., 1999, 2001; Avlund et al., 2004a,b; Giles et al., 2004; Zabalegui et al., 2006). The direction of this influence is the expected, i.e., the situation of loneliness is associated with a higher level of disability. If we look separately the two types of disability covered by this study, we find that marital loneliness seems to be associated with the instrumental disability and the subnet of friends with the two types of disability. This could be explained by the presence of the partner provides an important support for instrumental issues of daily life (housework, paperwork, money, medicines, etc.), whereas emotional loneliness caused by the lack of friends "undermines" the fellow to face problems of any kind. Although in the case of lack of friends it is possible to produce a reverse effect. Therefore, it seems that a situation of loneliness can have a significant effect on disability in this age group.

Conflict of interest statement: None.

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Table 1. Frequency of covariables, n, %, mean ± S.D.

Covariates	n	%
Age	1 250	73.0 ± 1.7
Gender	1 286	
males	546	42.5
females	740	57.5
Negative biographical events	1 276	
none	99	7.8
1. 2 or 3	855	67.0
4 or more	322	25.2
Profession of head of family	1 283	
manual workers	671	52.3
administrative and service	402	31.3
managers and professionals	210	16.4
Smoking	1 278	
non-smoker	796	62.3
ex-smoker	355	27.8
moderate smoker	70	5.5
smoker	57	4.5
Alcohol consumption	1 127	
non-drinkers	708	62.5
low consumption	341	26.5
moderate consumption	66	5.9
heavy drinking	9	0.8
high consumption	3	0.3
Physical activity	1 280	
no exercise	353	27.6
occasional	194	15.2
several times/month	76	5.9
several times/week	657	51.3
Depressive symptoms	1 214	10.4 ± 8.0
16 points or less	978	80.6
Over 16 points	236	19.4
Comorbidity	1 275	2.4 ± 1.7
2 diseases or less	722	56.6
3 diseases or more	553	43.4
Educational level	1 273	
did not go to school	178	14.0
did not complete primary	212	16.7
completed primary school	413	32.4
completed secondary school	341	26.8
university studies	129	10.1
Homeownership	1 273	
yes	1011	79.4
no	262	20.6
Family income	1 274	
900€ or less	593	46.5
More than 900€	278	21.8
Missing	403	31.6

Table 2. Comparison of the SNI scores and the covariables by ANOVA

	SNI		Soc.struct. index		Soc. particip. index	
	mean±S.D.	p <	mean±S.D.	p <	mean±S.D.	p <
Total population (n = 1,268)						
	0.92±0.34		0.58±0.19		0.34±0.25	
Gender (n = 1,286)						
Males (n = 546)						
	0.97±0.34	0.0005	0.61±0.18	0.0005	0.36±0.26	0.036
Females (n = 740)						
	0.88±0.33		0.55±0.19		0.33±0.24	
Negative biographical events (n = 1,276)						
No (n = 99)						
	0.82±0.27	0.001	0.55±0.19	0.272	0.26±0.19	0.001
1, 2 or 3 (n = 855)						
	0.91±0.34		0.58±0.19		0.34±0.26	
4 or more (n = 322)						
	0.92±0.33		0.59±0.18		0.37±0.26	
Profession of head of family (n = 1 283)						
Manual workers (n = 671)						
	0.91±0.34	0.482	0.57±0.19	0.192	0.34±0.25	0.879
Administrative and service (n = 402)						
	0.92±0.32		0.58±0.18		0.35±0.25	
Managers and professionals (n =210)						
	0.94±0.34		0.60±0.18		0.34±0.26	
Educational level (n = 1,095)						
Primary or less (n = 625)						
	0.92±0.33	0.329	0.59±0.17	0.077	0.33±0.24	0.010
Secondary or more (n = 470)						
	0.94	0.35	0.57	0.19	0.37	0.26
Smoking habits (n = 1,278)						
Non-smoker (n = 796)						
	0.92±0.33	0.005	0.57±0.19	0.107	0.35±0.25	0.007
Ex-smoker (n = 355)						
	0.95±0.33		0.60±0.18		0.35±0.26	
Moderate smoker (n = 70)						
	0.87±0.31		0.57±0.19		0.30±0.22	
Smoker (n = 57)						
	0.78±0.25		0.54±0.18		0.24±0.16	
Alcohol consumption (n = 1,127)						
Non-drinkers (n = 708)						
	0.89±0.33	0.038	0.57±0.19	0.367	0.32±0.19	0.058
Low consumption (n = 341)						
	0.95±0.33		0.59±0.18		0.37±0.25	
Moderate consumption (n = 66)						
	0.96±0.35		0.60±0.19		0.35±0.26	
Heavy drinking (n = 9)						
	0.97±0.26		0.63±0.19		0.35±0.22	
High consumption (n = 3)						
	1.10±0.46		0.57±0.18		0.53±0.39	
Physical activity (n = 1,280)						
No exercise (n = 353)						
	0.77±0.33	<0.0005	0.52±0.20	<0.0005	0.24±0.22	<0.0005
Occasional (n = 194)						
	0.90±0.31		0.58±0.18		0.32±0.23	

Several times/month (n = 76)					
1.02±0.31		0.62±0.18		0.40±0.25	
Several times/week (n = 657)					
0.99±0.32		0.60±0.18		0.39±0.26	
For age, depression, and comorbidities, we applied the Pearson-correlation					
Age (n = 1,250)					
R = -0.024	0.406	R = -0.055	0.051	R = 0.009	0.740
Depressive symptoms (n = 1,286)					
R = -0.174	<0.0005	R = -0.171	<0.0005	R = -0.104	<0.0005
Comorbidity (n = 1,286)					
R = -0.050	0.073	R = -0.059	0.034	R = -0.023	0.410

Table 3. Comparison of the SNI score and disability level, ANOVA

	SNI		Soc.struct. index		Soc. particip. index	
	mean±S.D.	p <	mean±S.D.	p <	mean±S.D.	p <
Total population (n = 1,268)						
	0.92±0.34	0.0005	0.58±0.19	0.007	0.34±0.25	0.0005
No disability (n = 834)						
	0.94±0.33		0.58±0.19		0.36±0.25	
Instrumental disability (n = 278)						
	0.92±0.34		0.57±0.18		0.34±0.26	
Basic disability (n = 147)						
	0.79±0.34		0.53±0.18		0.26±0.25	

Table 4. Results of multinomial logistic regression model to analyze the possibility of developing a BADL or IADL disability of those not suffering from any kind of disability

Variables	IADL disability OR(95%CI)	BADL disability OR(95%CI)
Model 1		
SNI	0.82(0.54-1.23)	0.23(0.13-0.42)**
Model 2		
SNI	0.73(0.48-1.09)	0.23(0.13-0.42)**
Gender (male)	1.90(1.44-2.50)**	1.00(0.69-1.45)
Model 3		
SNI	0.66(0.43-1.03)	0.31(0.17-0.56)**
Gender (male)	1.95(1.47-2.60)**	1.03(0.70-1.51)
Smoking (smoker)	0.78(0.49-1.25)	0.93(0.51-1.70)
Physical activity (no exercise)	0.88(0.66-1.18)	1.66(1.14-2.42)**
Model 4		
SNI	0.65(0.42-1.01)	0.27(0.15-0.50)**
Gender (male)	1.97(1.48-2.62)**	1.06(0.72-1.56)
Smoking (smoker)	0.77(0.48-1.24)	0.90(0.49-1.65)
Physical activity (no exercise)	0.89(0.66-1.19)	1.73(1.18-2.42)**
Negative biographical events		
1, 2 or 3	1.44(0.81-2.56)	1.02(0.53-1.97)
4 or more	1.71(0.92-3.17)	1.70(0.84-3.46)
Model 5		
SNI	0.70(0.46-1.11)	0.56(0.28-1.14)
Gender (male)	2.69(1.97-3.67)**	2.08(1.27-3.38)**
Smoking (smoker)	0.74(0.45-1.21)	0.91(0.45-1.87)
Physical activity (no exercise)	0.87(0.64-1.18)	1.51(0.97-2.36)
Negative biographical events		
1, 2 or 3	1.27(0.71-2.27)	0.88(0.38-2.01)
4 or more	1.49(0.79-2.79)	1.74(0.73-4.13)
Depressive symptoms	1.04(1.02-1.06)**	1.08(1.06-1.11)**
Comorbidity	1.24(1.13-1.36)**	1.48(1.30-1.67)**

Notes: *p < 0.05; **p < 0.01

Table 5. Results of the multinomial logistic regression model to analyze the possibility of developing a BADL or IADL disability of those not suffering any kind of disability. Full SNI, disaggregated by component and disability

Variables	IADL disability OR(95%CI)	BADL disability OR(95%CI)
SNI	0.82(0.54-1.23)	0.23(0.13-0.42)**
Disaggregated by component		
social structure	0.75(0.36-1.57)	0.31(0.12-0.79)*
social participation	0.86(0.50-1.48)	0.18(0.07-0.43)**
Disaggregated by subnets		
couple	1.56(1.14-2.12)**	1.07(0.72-1.59)
children/grandchildren	1.03(0.64-1.65)	1.38(0.74-2.55)
friends	0.52(0.36-0.76)**	0.51(0.32-0.84)**
brethren	0.75(0.44-1.26)	0.83(0.41-1.67)
confident	0.90(0.66-1.24)	0.71(0.47-1.07)
associations	1.18(0.85-1.62)	1.00(0.63-1.60)
social activities	0.54(0.24-1.22)	0.04(0.01-0.10)**

Notes: *p < 0.05 **p < 0.01

Table 6. HR and 95%CI of the Cox's regression model to analyze the possibility of developing any type of disability

Variable	HR(95%CI)
Model 1	
SNI	0.36(0.23-0.57)**
Model 2	
SNI	0.37(0.23-0.39)**
Model 3	
SNI	0.42(0.26-0.67)**
Model 4	
SNI	0.40(0.25-0.64)**
Physical activity (no exercise)	0.74(0.56-0.99)*
Model 5	
SNI	0.51(0.31-0.82)**
Comorbidity	1.27(1.17-1.38)**
Depressive symptoms	1.05(1.04-1.07)**

Notes: * $p < 0.05$; ** $p < 0.01$

Table 7. HR and 95%CI of the Cox's regression model to analyze the possibility of developing a BADL disability

Variable	HR(95%CI)
Model 1	
SNI	0.29(0.14-0.59)**
Model 2	
SNI	0.31(0.15-0.62)**
Model 3	
SNI	0.36(0.18-0.75)**
Model 4	
SNI	0.33(0.16-0.68)**
Model 5	
SNI	0.43(0.20-0.90)**
Comorbidity	1.28(1.13-1.44)**
Depressive symptoms	1.08(1.05-1.10)**

Notes: $p < 0.05$; ** $p < 0.01$